Report

Building 82 Area Remedial Approach

Prepared for

Union Carbide Corporation

A Wholly Owned Subsidiary of The Dow Chemical Company

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CH2MHILL

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Acronyms and Abbreviations

μg/kg	micrograms per kilogram
μg/L	micrograms per liter
AS/SVE	air sparge/soil vapor extraction
B(a)P	benzo(a)pyrene
BEHP	bis(2-ethylhexyl)phthalate
bgs	below ground surface
CSM	conceptual site model
Dow	The Dow Chemical Company
EC	environmental covenant
Facility	South Charleston Facility
FMC	FMC Corporation
HHRA	Human Health Risk Assessment
IM&M	Inspection, Maintenance, and Monitoring
MCL	maximum contaminant level
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RSL	Regional Screening Level
Site	Building 82 Area
SVOC	semivolatile organic compound
SWMU	solid waste management unit

TCE	trichloroethene
TEQ	toxicity equivalent
TM	technical memorandum
UCC	Union Carbide Corporation
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

SECTION 1

Introduction

This Remedial Approach Report addresses the portion of the South Charleston Facility (hereafter referred to as the "Facility") in South Charleston, West Virginia, that formerly contained Buildings 82 and 603. This report has been prepared for Union Carbide Corporation (UCC), a wholly owned subsidiary of The Dow Chemical Company (Dow). This area of the Facility is known as the "Building 82 Remediation Area," or simply the "Building 82 Area." Figure 1-1 provides a Facility overview and general location of the Building 82 Area.[1] UCC owns the Facility; however, the Building 82 Area was divested through donation to the University of Charleston in 2006. Environmental site investigations and remediation activities at the Facility are managed in accordance with United States Environmental Protection Agency (USEPA) Region 3 and the Resource Conservation and Recovery Act (RCRA) Facility Lead Agreement, dated December 15, 1999.

The Building 82 Area is one of 10 "remediation areas" identified at the Facility to help organize and manage remediation activities. There are five remediation areas on the Mainland and five remediation areas on Blaine Island (Figure 1-2). The remediation area boundaries were established geographically to generally include distinct groundwater plumes and their source areas by following current Facility features (for example, roads, buildings, fences, etc.) to the extent possible. However, these boundaries will not dictate where or how groundwater and soil remediation are conducted. The Building 82 Area (hereafter referred to as the "Site") is one of those 10 remediation areas, and the first area targeted for a groundwater monitoring remedy. More information on the Site is provided in the *Current Conditions Report, UCC South Charleston Facility* (CH2M HILL, 2010) and the Final Human Health Risk Assessment (HHRA) attached in Appendix A.

1.1 Purpose

The purpose of this report is to:

- Present the conceptual site model (CSM) for the Site;
- Summarize the results of the Final HHRA approved by USEPA in a letter dated November 23, 2011 (USEPA, 2011b). The Final HHRA incorporating USEPA comments as agreed in the November 23, 2011, letter is included as Appendix A;
- Present the Site remedial action objectives (RAOs);
- Present the remedies that were evaluated, the selected remedy and approach for its implementation, and the associated environmental covenants (ECs) placed on the Site.

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[1] The Facility Boundary for the Building 82 Area displayed on Figure 1-1 is estimated and will be revised at a later date to reconcile differences between the current understanding of the Facility boundary and that presented on drawing number A60021B of the *Volume I RCRA Part B Permit Application* (TRC 18-699-005), presented by UCC and prepared by TRC Environmental Corporation, March 1996.

1.2 Report Overview

This report is organized into four major sections:

- **Section 1 - Introduction**
- **Section 2 – Building 82 Area Overview**: Presents the Site history and CSM.
- **Section 3 – HHRA Results**: Presents a summary of the HHRA conducted at the Site.
- **Section 4 – Remedy Selection**: Defines the RAOs, remedial option, selected remedy, and ECs for the Site. The section also references the ECs (Appendix B) and groundwater monitoring plan (Inspection, Maintenance, and Monitoring [IM&M] Plan) for the Site (Appendix C).

SECTION 2
Building 82 Overview

2.1 Building 82 Area History

The Site encompasses approximately 6 acres in the southwestern portion of the Facility. Buildings 82 and 603 were once office buildings used for administrative functions until the late 1990s. A review of historical Sanborn maps indicates that the Site was once also occupied by a UCC machine shop (located in the southwestern portion of the Site approximately 100 feet south of Former Building 82) (Civil & Environmental Consultants, Inc., 2006) and a synthetic, Dynel® fiber manufacturing facility (located in the southeastern part of the Site about 100 feet south of Former Building 603). Other industries formerly located in this vicinity include a former FMC Corporation (FMC) facility located northwest of Former Building 82, and a laundromat and dry cleaning facility formerly located east of Former Building 603.

Building 603 was decommissioned and demolished by UCC in the early 2000s and the Site was divested to the University of Charleston in 2006. Following the divestiture, the University of Charleston divided the Site into seven land tracts and demolished Building 82 in 2009. Following demolition activities of both buildings, the debris was removed from the Site but the pavement and existing material making up the ground surface were left in place. Clean fill soils were then placed in these areas to a depth of at least 1 foot below ground surface (bgs) for grading purposes.

The Site currently consists of paved and grass-covered areas and is surrounded by industrial, commercial, and residential properties. The Site is bounded by Fifth Avenue and McCorkle Avenue (U.S. Route 60) on the north, Third Avenue on the south, B Street on the east, and C Street on the west. A Chevron service station is located immediately across B Street from the northeastern portion of the Former Building 603 Area, and a Speedway service station is located directly across Fourth Avenue from the northern extent of the Former Building 603 Area. Commercial businesses and two residential properties lie immediately across 3rd Avenue to the south. Figure 2-1 displays the current features of the Site and surrounding properties.

2.1.1 Building 82 Area Conceptual Site Model

Historical environmental surveys conducted in the mid-1980s did not identify storage or handling of hazardous wastes at the Site. In addition, no solid waste management units (SWMUs) have been identified on the Site. Investigative activities took place at the Site from 2002 to 2011 for the purpose of evaluating the subsurface soil and groundwater. The data collected during this time have characterized the nature and extent of contamination, and are appropriate for use in the HHRA and determination of the remedial approach for the Site.

2.1.2 Geology and Hydrogeology

The upper fill material at the Site ranges from 1 to 5 feet in thickness and varies in composition within each tract. The upper material within Tract 3 and Tract 7 consists of approximately 1 foot of clean fill soil overlying pavement or other ground cover materials. The pavement and cover materials were left in place following demolition activities and extend to approximately 2.5 feet bgs. The clean fill soil within Tract 3 was placed by the University of Charleston subsequent to the demolition of Building 82 in 2009. The clean fill within Tract 7 was obtained by UCC from a formerly undeveloped site located adjacent to Corridor G during construction of a church in 2003 and placed after demolition debris was removed. The remainder of the tracts at the Site are paved or covered with grass or other landscaping material that extend to depths ranging from 3 to 5 feet bgs. The soils that underlie the cover material are "native" and consist of silty clay and silt to depths of approximately 28 feet bgs. These fine-grained soils are underlain by silty sand down to the bedrock surface at approximately 55 feet bgs.

Groundwater occurs in the silty sand beneath the Site and ranges from approximately 28 to 32 feet bgs. There is evidence of possible limited, shallow (5 feet bgs) perched groundwater beneath the Site, as observed through groundwater levels measured in 2004 in one soil boring (SCFM-C-06) located approximately 150 feet south of Former Building 82. This is an anomaly not encountered elsewhere at the Site (CH2M HILL, 2004). Groundwater beneath the Site and the southwestern portion of the Mainland Area of the Facility flows under the influence of a low hydraulic gradient. As displayed in Figure 2-2, groundwater beneath the Site flows generally to the north toward the Kanawha River.

2.1.3 Impacts to Soil

During the investigation work, a total of 50 soil samples were collected from depths ranging from 0.5 to 8.5 feet bgs from 41 soil borings. The analytical data were obtained during investigation work conducted in 2002, where soil samples were collected around Building 603 (borings numbered SB-1 through SB-13) (Table 1, Appendix A) and in 2004 where soil samples were collected around Building 82 (numbered SCFM-C-01 through SCFM-C-08) (Table 2, Appendix A). Additional surface soil samples were collected in 2010 (locations numbered SS-01 through SS-12) throughout the Site to supplement the HHRA and in 2011 (locations numbered SS-13 through SS-20) (Table 3, Appendix A) to delineate a potential localized area of elevated polynuclear aromatic hydrocarbons (PAHs) southwest of the Former Building 603 (Table 4, Appendix A). The soil samples collected in 2002, 2004, and 2010 were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), and metals. The 2011 soil samples were collected for the purpose of delineating the extent of PAHs in the soils around 2010 sample location SS-03; therefore, samples were analyzed for SVOCs only.

Figure 2-3 shows the soil sampling locations. Figure 2-4 presents the distribution of detected VOCs at the Site and Figure 2-5 presents the distribution PAH concentrations as benzo(a)pyrene [B(a)P] toxicity equivalent (TEQ)[2] concentrations at the Site. Detected

[2] B(a)P equivalents were calculated for HHRA purposes based on guidance provided in the *USEPA RSL User's Guide* (USEPA, 2011c). B(a)P TEQs were selected for presentation to simplify the numerous PAH detections into one (toxic equivalent) value, for comparison to screening criteria. Refer to Appendix A for further detail regarding B(a)P TEQs and associated screening criteria comparison.

SVOCs bis(2-ethylhexyl)phthalate (BEHP) and hexachlorobutadiene are not represented on Figure 2-5 because of the isolated instances of detection. Sample locations on Figures 2-4 and 2-5 that do not display associated callout boxes reported only non-detect concentrations for the represented constituents. Metals and PCBs results are discussed below but are not illustrated on figures because the majority of concentrations were either not detected above detection limits or were detected at concentrations less than the screening criteria used for comparison. Summary statistics and screening-level comparisons are presented in Tables 8, 9, and 10 of Appendix A for current surface soils, potential future surface soils, and future total soils, respectively. Screening criteria utilized in the HHRA and discussed in this document were based on USEPA Regional Screening Levels (RSLs) (USEPA, 2011c) that were current at the time the HHRA was authored and accepted, and the target risks and target hazards specified in Appendix A.

VOCs

VOCs were below screening criteria in all soil samples analyzed at the Site. The highest concentrations of VOCs in soil at the Site were detected from 5.5 to 7.5 feet bgs in SB-5, located in Tract 7 approximately 150 feet south of Former Building 603. Tetrachloroethene (PCE) was detected in this sample (245 micrograms per kilogram [μg/kg]) along with lower concentrations of trichloroethene (TCE) (11.6 μg/kg), cis-1,2-DCE (10 μg/kg), and chloroform (4 μg/kg). PCE was also detected (8.27 μg /kg) in surface soil sample SS-02 and ethyl acetate was detected (71.8 μg /kg) in one subsurface soil sample (SB-7). VOCs detected at these locations are below screening criteria and chlorinated VOCs such as PCE may have been associated with the laundromat formerly located east of Former Building 603.

Benzene (19.3 μg /kg) and xylene (28.9 μg /kg) were each detected in one soil sample (SS-07 and SCFM-03, respectively), and toluene was detected in three soil samples that ranged in concentration from 0.872 μg /kg within SB-1 to 6.4 μg /kg within SS-11. Concentrations for each of these three constituents were detected below screening criteria, although their origin is unknown.

Acetone and 2-butanone were detected below screening criteria within several soil sampling locations throughout the Site but are considered common laboratory chemicals and may have been introduced from laboratory cross-contamination rather than from the Site (USEPA, 1989). Other VOCs such as carbon disulfide and hexachlorobutadine are present in soil samples at the Site (primarily within Tract 7) but these are detected below reporting limits (“J”-qualified values) and associated screening levels.

SVOCs

SVOC concentrations were below RSLs in all samples from Tracts 1, 2, 3, 4, 5, and 6. SVOC concentrations exceeded screening levels in several limited areas in Tract 7 as described in the following paragraphs.

The highest SVOC concentrations in soil at the Site were PAHs at location SS-03 and surrounding delineation samples collected from 1.5 to 2.5 feet bgs within an approximate 400 square foot area (see inset of Figure 2-5). B(a)P equivalent concentrations in this area are above residential, trespasser, and/or industrial RSLs at each sampling location (with the exception of SS-19) and range from 3,675 μg /kg at SS-20 to 24,654 μg/kg at SS-14.

Shallower soil samples (0 to 1 foot bgs) collected in this area from the overlying clean soil fill show that B(a)P equivalent concentrations are below RSLs and are several orders of magnitude lower than those reported in the underlying material. Additional soil sampling locations where B(a)P equivalent concentrations are above residential , trespasser, and industrial RSLs are also located within Tract 7 and include SB-01 (4,126 µg/kg) collected from 2 to 4 feet bgs and SS-02 (2,901 µg/kg) collected from 0.5 to 1.5 feet bgs.

Because there were no known Site-related activities in this area that could have resulted in releases of B(a)Ps to soil, the B(a)Ps concentrations detected above screening criteria within the vicinity of SS-03 and two other locations are most likely attributed to the asphalt that was left in place after the building debris was removed. B(a)P equivalent concentrations detected within the overlying material at the sample SS-03 area confirm that clean fill soil was placed after demolition activities were completed.

Additional SVOCs that were detected below screening levels include BEHP collected from borings SB-13 (14,800 µg/kg) and SCFM-C-05 (623 µg/kg), and hexachlorobutadiene collected from boring SB-05 (1.7 J [estimated]). These constituents appear to be isolated impacts because they were not reported in any other sample.

Metals

The metals concentrations at the Site were either detected at concentrations below the associated screening criteria or were detected within the range of the mean natural background level in soil for the State of West Virginia (WVDEP, 2001). Arsenic, barium, chromium, lead, nickel, and selenium were detected in most soil samples collected throughout the Site, and mercury and cadmium were detected in a small subset of these.

PCBs

Aroclor-1260 (PCB) was detected in four isolated soil samples that are below screening criteria: at 180 µg/kg in SB-13 from 2-4 feet bgs; at 149 µg/kg in SCFM-C-03 from 4-5 feet bgs; at 56.3 µg/kg in SS-02 from 0.5-1.5 feet bgs; and at 249 µg/kg in SS-03 from 1.5-2.5 feet bgs.

2.1.4 Impacts to Groundwater

Groundwater at the Site has been characterized by three piezometers (PZ039, PZ040, and PZ041) (Table 5, Appendix A) and two monitoring wells (MW021 and MW028D) (Table 6, Appendix A) that have been sampled numerous times from 2003 to 2010, and by 14 groundwater grab samples (SCFM-C-01-GW through SCFM-C-14-GW) (also Table 6, Appendix A) that were collected in 2004 to supplement the well data. MW021 was destroyed during pre-demolition activities of Building 82; as a result, MW028D was installed near the former MW021 and screened at a similar depth, and sampled in 2010 as a replacement well. The groundwater samples were analyzed for VOCs from each well from 2003 through 2010 and from each groundwater grab sample collected in 2004. SVOCs were analyzed at selected wells from 2003 through 2008 and at each groundwater grab sampling location in 2004. Sampling for SVOCs has not been performed since 2008 because any detected SVOCs were below screening levels. Metals were sampled in 2003 from selected wells and in 2004 from each groundwater grab sampling location. Sampling for metals was discontinued after 2004 because detected metals were at concentrations below screening criteria.

Figure 2-6 displays the locations of the wells and groundwater grab sampling locations, while Figures 2-7 and 2-8 present the distribution of VOCs and SVOCs, respectively, at the Site. Sample locations that do not display associated callout boxes contain groundwater concentrations that were non-detect. Metals results are discussed below but are not illustrated on a figure because the majority of concentrations were either not detected or were detected at concentrations below screening criteria. Summary statistics and screening-level comparisons are presented in Tables 11 and 12 of Appendix A for evaluation of the direct contact and vapor intrusion exposure pathways, respectively. Further discussion of the screening criteria is also detailed in Appendix A.

VOCs

VOCs detected in groundwater beneath the Site at concentrations above screening criteria include chlorinated volatiles such as carbon tetrachloride and its degradation products, which have been reported at increasing concentrations in the Site's northernmost wells in the last decade. Additionally, dry cleaning-related solvents such as PCE and vinyl chloride were detected at concentrations above tap water RSLs and/or maximum contaminant levels (MCLs) in groundwater samples collected within Tract 7, which includes the area where the laundromat/dry cleaner was formerly located. Isolated benzene detections (concentrations greater than the tap water RSL and the MCL) have also been reported in Site groundwater beneath Tracts 3 and 5 and appear to be related to the nearby fuel station.

Carbon tetrachloride was detected in piezometer PZ041 and wells MW021 and MW028D from 2003 through 2010, and at groundwater grab sampling locations SCFM-05 and SCFM-08 in 2004. Each of these locations is in the northern portion of the Site, and concentrations ranged from 7.36 microgram per liter (µg/L) at location SCFM-05 (collected in 2004) to 79.7 µg/L at piezometer PZ041 (collected in 2010). MW021 was sampled five times between 2006 and 2008 before it was destroyed, and carbon tetrachloride concentrations at the well during that period increased from 14.6 to 60.7 µg/L. Carbon tetrachloride was detected in samples collected from replacement well MW028D at concentrations of 10.6 µg/L in February 2010 and 5.47 µg/L in October 2010. Carbon tetrachloride concentrations in piezometer PZ040 increased slightly from non-detect in 2003 to 6.01 µg/L in 2010. The detected concentrations of carbon tetrachloride exceed the tap water RSL, the MCL, and residential and industrial screening criteria for evaluation of the groundwater-to-indoor air vapor intrusion exposure pathway.

The source of the carbon tetrachloride in groundwater beneath the Site has not been identified, although it does not appear to have migrated from upgradient of the Facility. While carbon tetrachloride occurs in Facility groundwater just north of McCorkle Avenue, it is comingled with the primary groundwater contaminants in this area of the Facility — 1,2-dichloroethane and 1,2- dichloropropane — which are several orders of magnitude higher in concentration than carbon tetrachloride. However, 1,2-dichloroethane and 1,2-dichloropropane are not present in groundwater beneath the Site. Because these contaminants that occur north of McCorkle Avenue at much higher concentrations than carbon tetrachloride have not migrated upgradient to the Site, it is unlikely that carbon tetrachloride migrated upgradient to the Site from the Facility independent of other Facility-related groundwater constituents. The organic carbon/water partition coefficients (K_{oc}) for carbon tetrachloride, 1,2-dichloropropane, and 1,2-dichloroethane are similar (USEPA, 2011c); thus, adsorption to soil and migration rates would be expected to be similar for the three VOCs.

Chloroform was also detected at the same locations as carbon tetrachloride (along with SCFM-C-09 and with the exception of SCFM-C-05), although at lower concentrations. Concentrations at these locations ranged from 1.79 μg/L at MW028D in 2010 to 21.3 μg/L at groundwater grab sample location SCFM-C-08 in 2004. All detected chloroform concentrations exceeded the tap water RSL, and many also exceeded residential RSLs for protection of indoor air via the vapor intrusion pathway. Concentrations are less than the RSL for protection of industrial indoor air. Based upon the similar distribution of chloroform and carbon tetrachloride, and the fact that chloroform is a degradation product of carbon tetrachloride, chloroform may have originated from the same source as carbon tetrachloride.

PCE (2.57 μg/L) and TCE (1.64 μg/L) were both detected in piezometer PZ039 during the 2007 and 2010 groundwater sampling events, and PCE concentrations were reported above the associated tap water RSL. TCE concentrations were all below screening criteria. Vinyl chloride (18.3 μg/L) was detected in one groundwater grab location (SCFM-C-13) approximately 100 feet northeast of Former Building 603 at a concentration greater than the tap water RSL, the MCL, and the RSL for protection of residential indoor air. Each of these constituents may have been associated with the dry cleaning facility formerly located on the Site.

Benzene was detected in one groundwater grab location (SCFM-C-08) approximately 100 feet east of Former Building 603 at a concentration of 7.54 μg/L and within the former well MW021 at a concentration of 6.62 μg/L (2008). Both detected benzene concentrations are greater than the associated tap water RSL and the MCL. Benzene was not detected within replacement well MW028D during the 2010 sampling event. Xylene was also detected below RSLs and MCLs during a sampling event in 2003 within piezometer PZ039, located approximately 300 feet east of Former Building 603. Benzene and xylene in groundwater at the Site may be associated with one or both of the gas stations currently located adjacent to the Site.

Acetone was also detected below RSLs and MCLs during the 2003 sampling event within piezometer PZ039 and may have been introduced as a common laboratory contaminant.

SVOCs

SVOCs detected in groundwater beneath the Site include BEHP and select PAHs collected primarily from groundwater grab sample locations. SVOCs detections reported from a permanent monitoring well sample include phenol (180 μg/L) and di-n-octylphthalate (8.95 μg /L) detected in piezometers PZ039 and PZ040, respectively, during the 2003 sampling event, and BEHP (10.4 μg/L) detected in PZ039 during the 2007 sampling event. Phenol and di-n-octylphthalate concentrations are below MCLs and RSLs, but the concentration of BEHP in PZ039 is above the tap water RSL and the MCL. BEHP was also detected in several groundwater grab samples (ranging from 6.37 to 21.3 μg/L) throughout the Site at concentrations greater than the tap water RSL and the MCL. As noted with respect to Site soils, BEHP concentrations appear to be isolated impacts.

PAHs (benzo(k)fluoranthene, fluoranthene, and phenanthrene) were detected in two groundwater grab samples (SCFM-C-06 and SCFM-C-02) collected on the southwest side of the Site. Benzo(k)fluoranthene concentrations are greater than the tap water RSL, but fluoranthene and phenanthrene detections were less than associated screening criteria. B(a)P was not detected in any of the groundwater grab samples at the Site. SVOCs that exceed criteria within select groundwater grab samples rather than samples collected from permanent monitoring wells may be related to higher turbidity groundwater collected from the groundwater grab sampling locations.

Metals

In 2003 and 2004, barium and selenium were detected in groundwater throughout the Site and lower levels of arsenic, chromium, lead, and nickel were also detected in grab sample SCFM-C-08 in Tract 5. Mercury was not detected in any of the 2004 groundwater grab samples or in wells sampled in 2003 and 2004. Metals constituents observed in groundwater at the Site were reported at concentrations below screening criteria, with the exception of arsenic and barium, each of which exceeded respective tap water RSLs.

SECTION 3

HHRA Results

A screening-level HHRA was performed for the Site to evaluate potential risks to human health for current and potential future soil and groundwater exposure pathways. The screening-level HHRA was originally submitted to USEPA as a technical memorandum (TM) in September 2006 (CH2M HILL, 2006). USEPA comments on the TM were provided on December 2, 2009 (USEPA, 2009), and responses and required revisions were included in the screening-level HHRA report submitted to USEPA on July 14, 2011 (CH2M HILL, 2011a). Comments on this document were then received September 15, 2011 (USEPA, 2011a) and responded to on October 20, 2011 (CH2M HILL, 2011b). USEPA acceptance of the screening-level HHRA was provided on November 23, 2011 (USEPA, 2011b), and the final revisions are included in Appendix A of this report.

The screening-level HHRA was performed to evaluate potential exposures under one current land use condition (i.e., current trespasser) and four future land use conditions (i.e., future residential, future trespasser, future commercial/industrial, and future construction activities). Although it is unlikely that receptors could potentially be exposed to surface soil because most of the Site is currently paved or grass-covered, potential exposure to surface soil by current and future receptors was evaluated. The screening-level HHRA also took into consideration that Buildings 82 and 603 had been demolished and that the deed of sale for the Site contains language limiting redevelopment in some areas of the property to commercial and/or industrial use and prohibiting the use of groundwater as potable water. In addition, an environmental covenant will be filled for the Site with these same restrictions. As a result of the groundwater use restriction, risk estimates for direct contact with groundwater were not calculated for VOC and SVOC concentrations detected above associated screening criteria as described in Section 2.1.4. Groundwater VOC concentrations were evaluated for potential risk to human health via the vapor intrusion pathway. Results of the screening-level HHRA are summarized for each receptor population:

- Estimated risks to current and future trespassers from potential exposure to surface soil are below or within the risk management range;[3]
- Risk results for future construction workers in contact with surface and subsurface soil during excavation or construction activities are within the risk management range;[4]
- Risk estimates for future commercial/industrial workers at the Site from exposure to surface soil and groundwater via the vapor intrusion pathway are also within the risk management range; and
- Results of the future residential land use evaluation indicate potential risks above USEPA's risk management range at some locations for future exposure to soil primarily associated with PAHs and groundwater via the vapor intrusion pathway.

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[3] Excess lifetime cancer risk of $1x10^{-6}$ to $1x10^{-4}$ and noncancer hazards below the threshold of 1.

[4] Noncancer hazards were not calculated for the construction worker soil exposure scenario because identified constituents in total soil do not have associated noncancer toxicity information.

SECTION 4

Remedy Selection

This section presents the basis for selection of the Building 82 Area remedy. As discussed earlier in this document, some Site soil and groundwater impacts with risks that exceed USEPA's risk management range are not subject to RCRA Corrective Action or are from an offsite (non-UCC) source. However, UCC will still implement remedies at the site to be protective of human health and the environment.

4.1 Facility Remedial Action Objectives

Remedial action objectives (RAOs) have been developed for the Facility based on site-specific conditions discussed in Section 2. These RAOs are established in accordance with the RCRA framework to be protective of human health and the environment, and were approved by USEPA in the *Groundwater Performance Criteria Report* (CH2M HILL, 2009). The RAOs that apply to the Site are summarized below.

- Prevent direct human exposure to groundwater by restricting groundwater use at the Site.
- Prevent exposure pathways for human receptors in areas where vapor intrusion may be a potential concern.
- Prevent exposure pathways for human receptors in areas where soil concentrations exceed USEPA's risk management range.

4.2 Remediation Drivers

Based on the RAOs discussed above, the following factors are the primary remediation drivers for the Site:

Groundwater

Groundwater impacts are observed at the Site that, based on investigations, do not appear to be related to the Facility. The three primary constituents impacting groundwater (carbon tetrachloride, chloroform, and vinyl chloride) appear related to non-Facility sources, although the source of vinyl chloride is likely the former dry cleaner that was once located at the Site. Related to the impacts in groundwater, there are potential risks to human health that are above USEPA's risk management range for exposure to groundwater via vapor intrusion into new buildings.

Soil

Subsurface soils in Tract 7 are impacted primarily with PAHs related to former asphalt surfaces that were broken up during demolition activities and later covered with clean fill. The HHRA (Section 3, Appendix A) identified potential risks above USEPA's risk management range for future residential receptors. While the origin of the PAHs means they are not subject to RCRA Corrective Action, UCC will still take action to protect human health because of the potential risks. Soils in Tract 3 are also identified solely for commercial/industrial reuse due to restrictions authored in the deed of sale for the Site.

4.3 Remedy Evaluation/Selection

Potential remedies were evaluated to meet the RAOs for the Facility. Technologies were evaluated using the USEPA threshold criteria (protect human health and the environment, achieve media cleanup objectives, and control the source[s]) and balancing criteria (long-term reliability and effectiveness; reduction of toxicity, mobility, or volume of wastes; short-term effectiveness; implementability; cost). A description of each technology is provided in Table 4-1, including a summary of the evaluation against the criteria.

4.3.1 Groundwater

Remedy Evaluation

For groundwater, three possible alternatives were evaluated, which are described below.

- Alternative 1 – Institutional Controls and Monitoring:
  - Groundwater monitoring to assess changes in concentrations over time
  - Institutional controls to address potential vapor intrusion into new occupied buildings
  - Institutional controls to prohibit the use of groundwater for purposes other than monitoring or remediation
- Alternative 2 – Air Sparge/Soil Vapor Extraction (AS/SVE) System and Institutional Controls:
  - Install vertical AS/SVE wells along the perimeter of the Site to treat contaminated groundwater migrating onto the Site
  - Groundwater monitoring to assess changes in concentrations over time
  - Institutional controls to address potential vapor intrusion into new occupied buildings
  - Institutional controls to prohibit the use of groundwater for purposes other than monitoring or remediation
- Alternative 3 – Groundwater Recovery System and Institutional Controls:
  - Install vertical recovery wells along the perimeter of the Site to prevent contaminated groundwater from migrating onto the Site
  - Groundwater monitoring to assess changes in concentrations over time
  - Institutional controls to address potential vapor intrusion into new occupied buildings
  - Institutional controls to prohibit the use of groundwater for purposes other than monitoring or remediation

Selected Remedy

Alternative 1 was selected as the remedy for groundwater because there are no current exposures and potential future exposures can be effectively controlled by the implementation of institutional controls and a groundwater monitoring program. Institutional controls will consist of an EC pursuant to the Uniform Environmental Covenants Act, West Virginia Code Chapter 22, Article 22B.

The EC would prohibit the use of groundwater for purposes other than monitoring or remediation, and would require installation of a vapor mitigation system on any new occupied structures constructed at the Site. Additionally, the City of South Charleston has an ordinance in place for this area prohibiting groundwater use due to existing groundwater contamination emanating from the nearby FMC facility. The ordinance is inclusive of Tracts 1, 2, 3, 4, and 5 at the Site but does not include Tracts 6 and 7. Therefore, the selected remedy does not affect a potentially potable source of water. The institutional controls are necessary regardless of the alternative because observed improvements in groundwater quality would not be expected for some time under any of the alternatives.

The other alternatives were rejected because the groundwater impacts at the Site are primarily related to offsite source(s) and, therefore, these remedies (AS/SVE and groundwater recovery) would not address the source of contamination. For the groundwater recovery system alternative, there is the added concern that this alternative could exacerbate the extent of groundwater contamination from the source(s). Because the source would not be addressed, these remedies would need to be operated for an extended period, which is less sustainable than the selected remedy given that the systems would generate carbon emissions and wastes for treatment that would not otherwise be produced. In addition, there would be additional costs for continued operation and maintenance of an active system that provides little or no environmental benefit because the groundwater recovery system would not address the source, nor would it address the majority of the plume, thereby providing no further protection for human health since potable use of groundwater is prohibited. Finally, the presence of active operating remediation systems on the Site would limit future redevelopment opportunities without providing any additional protection relative to the selected remedy.

4.3.2 Soil

Remedy Evaluation

For subsurface soil at Tracts 3 and 7, three possible alternatives were evaluated, which are described below.

- Alternative 1 – Institutional Controls:
  - Restrict land use to industrial/commercial
  - Institutional controls to manage potential future contact with impacted soil or movement of impacted soil
- Alternative 2 – Limited Soil Excavation and Institutional Controls:
  - Restrict land use to industrial/commercial

  - Excavation and offsite disposal of soils impacted above USEPA's risk management range for future residential users

- Alternative 3 – Soil Cover
  - Restrict land use to industrial/commercial
  - Institutional controls to require maintenance of the existing clean fill as a soil cover to prevent direct contact with the impacted soil
  - Institutional controls to prohibit excavating into the soil cover

Selected Remedy

Alternative 1 was selected as the remedy for soil because potential exposures can be effectively controlled by restricting the future land use. The use restriction is consistent with current zoning and with the current and proposed future use for this area as detailed in Section 3. In addition, the impacts in soil are limited in extent and appear to be related to the former asphalt surfaces, which are not subject to RCRA corrective action.

The other remedial alternatives were rejected because there are only isolated impacts in subsurface soil and, therefore, no currently complete exposure pathways. Future potential exposure to impacted soil will be managed by utilizing institutional controls so that excavation and offsite disposal of impacted soils are not necessary.

4.4 Summary of the Selected Remedy

The selected remedy for the Site consists of institutional controls and groundwater monitoring.

Institutional Controls

The institutional controls will contain the following elements:

- Prohibit use of groundwater (all tracts)
- Restrict land use to industrial/commercial (Tracts 3 and 7 only)
- Prohibit movement of soil off the tract unless it is determined that the soil can lawfully be moved (Tracts 3 and 7 only)
- Require incorporation of a vapor barrier or other approved engineering controls into new occupied buildings to limit potential vapor exposure (all tracts)

The institutional controls will be implemented using an EC. Appendix B contains draft language for the ECs that will be applied. Institutional controls will be monitored in accordance with the IM&M Plan included in Appendix C.

Groundwater Monitoring

The primary objective for groundwater monitoring at the Site is to evaluate constituent concentration trends. The IM&M Plan (Appendix C) includes the following elements for groundwater monitoring:

- Wells to sample and sample frequency

- Target analyte list
- Data evaluation
- Evaluation of the effectiveness of the monitoring program
- Reporting requirements

Deviations to site conditions that would alter the monitoring approach will be communicated to the USEPA and addressed through a revision to the IM&M Plan.

SECTION 5

References

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U.S. Environmental Protection Agency (USEPA), 1989. *Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, Part A, Interim Final.* Office of Solid Waste and Emergency Response. EPA/540/1-89/002. December.

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USEPA, 2011a. Letter to Erich Weissbart, RPM, USEPA Office of Remediation, from Ruth Prince, Toxicologist, USEPA Office of Technical and Administrative Support. Subject: UCC South Charleston Screening Level Human Health Risk Assessment for the Area of Former Buildings 82 and 603, dated July 2011. September 15.

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USEPA, 2011c. *USEPA RSL User's Guide,* "Regional Screening Level (RSL) Table." June.

West Virginia Department of Environmental Protection (WVDEP), 2001. *West Virginia Voluntary Remediation and Redevelopment Act, Guidance Manual*. West Virginia Department of Environmental Protection, Office of Environmental Remediation.

Table

Table 4-1
Building 82 Area Groundwater and Soil Remedial Technologies Screening
South Charleston Facility
South Charleston, West Virginia

Remedial Technology	Process Options	Descriptions	Effectiveness	Implementability	Relative Cost[1]	Screening Comment
Groundwater						
Institutional Controls						
Access and Use Restrictions	Environmental Covenants	Environmental covenants implemented for impacted areas to restrict property use and groundwater use.	Effective for mitigating human exposure to impacts on the Site; however, not effective at remediating groundwater.	Implementability: High	Capital: Low cost related to establishing the environmental covenants Operation & Maintenance (O&M): Low costs for inspecting compliance the environmental covenants.	Suitable to eliminate potentially completed exposure pathways for human health.
Monitoring						
Groundwater Monitoring	None	Monitoring of groundwater.	Effective for monitoring constituent concentration trends over time.	Implementability: High	Capital: Low cost for establishing the monitoring program. O&M: Low cost for sampling and reporting.	Monitoring the groundwater concentrations over time will be used to evaluate changes in groundwater conditions.
In Situ Treatments						
Physical	Recovery Wells to Pump and Treat Groundwater	Install recovery wells to intercept contaminated groundwater migrating onto the Site. Groundwater pumped from the recovery wells would be treated at the South Charleston publicly owned treatment works (POTW).	Effective at controlling additional groundwater contamination migrating onto the Site; however, not effective at remediating the source of the groundwater contamination.	Implementability: High. However, additional testing will be required to determine the radius of influence of individual wells and capture zone of the hydraulic barrier.	Capital: Medium cost for designing and installing the system. O&M: High cost	Installing a groundwater recovery system to control contaminated groundwater migrating onto the Site is not considered a sustainable measure because the system may need to operate and be maintained indefinitely.
Physical	Air Sparging (AS)/ Soil Vapor Extraction (SVE)	AS technology involves the injection of air into groundwater through wells. VOCs in groundwater are removed primarily through volatilization. Aerobic biodegradation is also enhanced by air injection. VOCs stripped from groundwater are captured and treated using SVE and vapor treatment technologies.	Effective at treating contaminated groundwater migrating onto the Site; however, not effective at remediating the source of the groundwater contamination.	Implementability: Medium. The vadose zone is comprised of lower permeability soils, which may hinder recovery of contaminants through SVE. Soil fracturing may be required to improve secondary permeability in the vadose zone.	Capital: Medium cost for designing and installing the system. O&M: Medium cost	Installing an AS/SVE system to treat contaminated groundwater migrating onto the Site is not considered a sustainable measure because the system may need to operate and be maintained indefinitely.

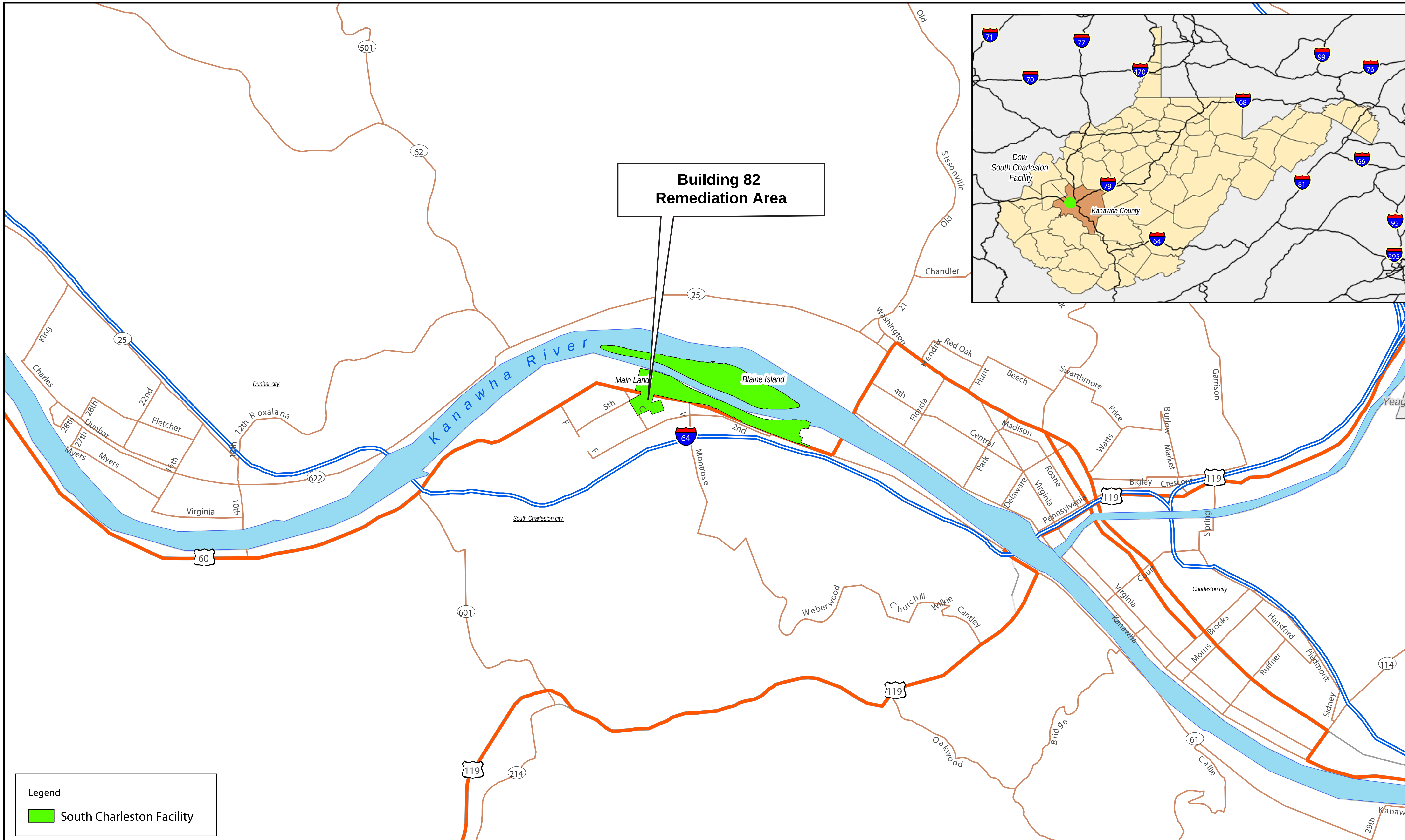
[1] The costs are relative to the other technologies being evaluated for each media.

Table 4-1
Building 82 Area Groundwater and Soil Remedial Technologies Screening
South Charleston Facility
South Charleston, West Virginia

Remedial Technology	Process Options	Descriptions	Effectiveness	Implementability	Relative Cost[1]	Screening Comment
Soil						
Institutional Controls						
Access and Use Restrictions	Environmental Covenants	Environmental covenants issued for impacted areas to restrict property use and groundwater use.	Effective for mitigating human exposure to impacted subsurface soil; however, not effective in remediating the impacted soil.	Implementability: High	Capital: Low cost related to establishing the environmental covenants. O&M: Low costs for inspecting compliance the environmental covenants.	Suitable to eliminate potentially completed exposure pathways for human health.
Excavation and Disposal						
Excavation and Disposal	Excavation and Offsite Disposal to RCRA Subtitle C or Subtitle D Landfill	Excavate contaminated soil for disposal in permitted landfill.	Effectiveness: High	Implementability: High	Capital: Medium cost O&M: None	The impacts in soil are limited in extent and are related to the former asphalt parking lots, which are not subject to Resource Conservation and Recovery Act corrective action.
Soil Cover						
Soil Cover	Soil Cover	Utilize the clean fill above the impacted soil as a soil cover.	Effective for mitigating human exposure to impacted subsurface soil; however, not effective in remediating the impacted soil.	Implementability: High	Capital: None O&M: None	The soil cover would need to be used in conjunction with institutional controls to prohibit excavating into the soil cover. In addition, a soil cover would limit future redevelopment opportunities.

[1] The costs are relative to the other technologies being evaluated for each media.

Figures



0 3,000 6,000
Feet

Figure 1-1
Facility Overview and Site Location Map
Building 82 Area Remedial Approach Report
UCC South Charleston Facility, South Charleston, West Virginia

CH2MHILL

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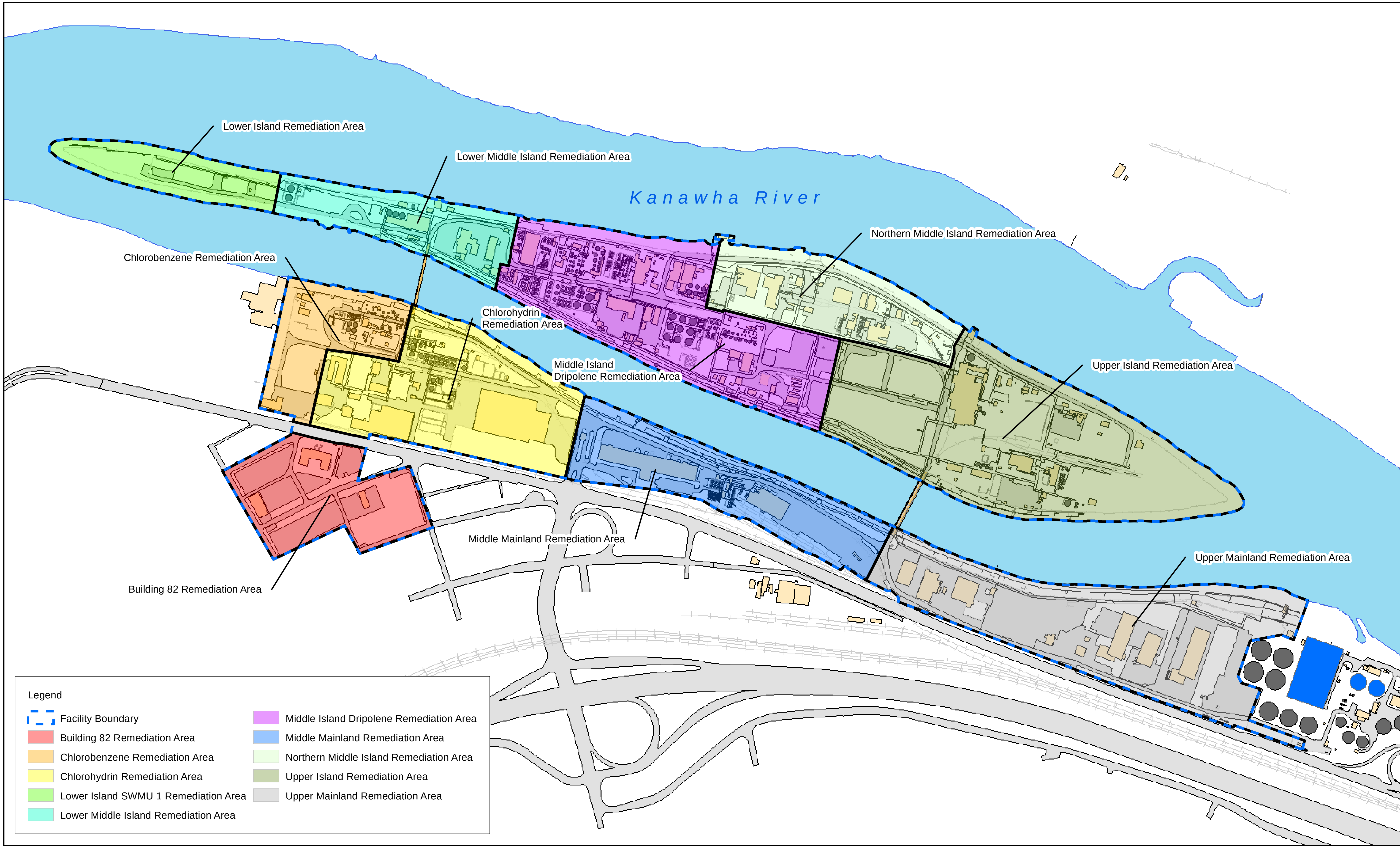

N

0 500 1,000

Feet

Figure 1-2
South Charleston Facility Remediation Areas
Building 82 Remedial Approach Report
UCC South Charleston Facility, South Charleston, West Virginia

E:\GIS\DOW\SOUTHCHARLESTON\REPORTS\428946_SCF_BLDG82\MAPFILES\FIGURE 01-02 - SOUTH CHARLESTON FACILITY REMEDIATION AREAS.MXD JHANSEN1 4/19/2012 9:40:00 AM

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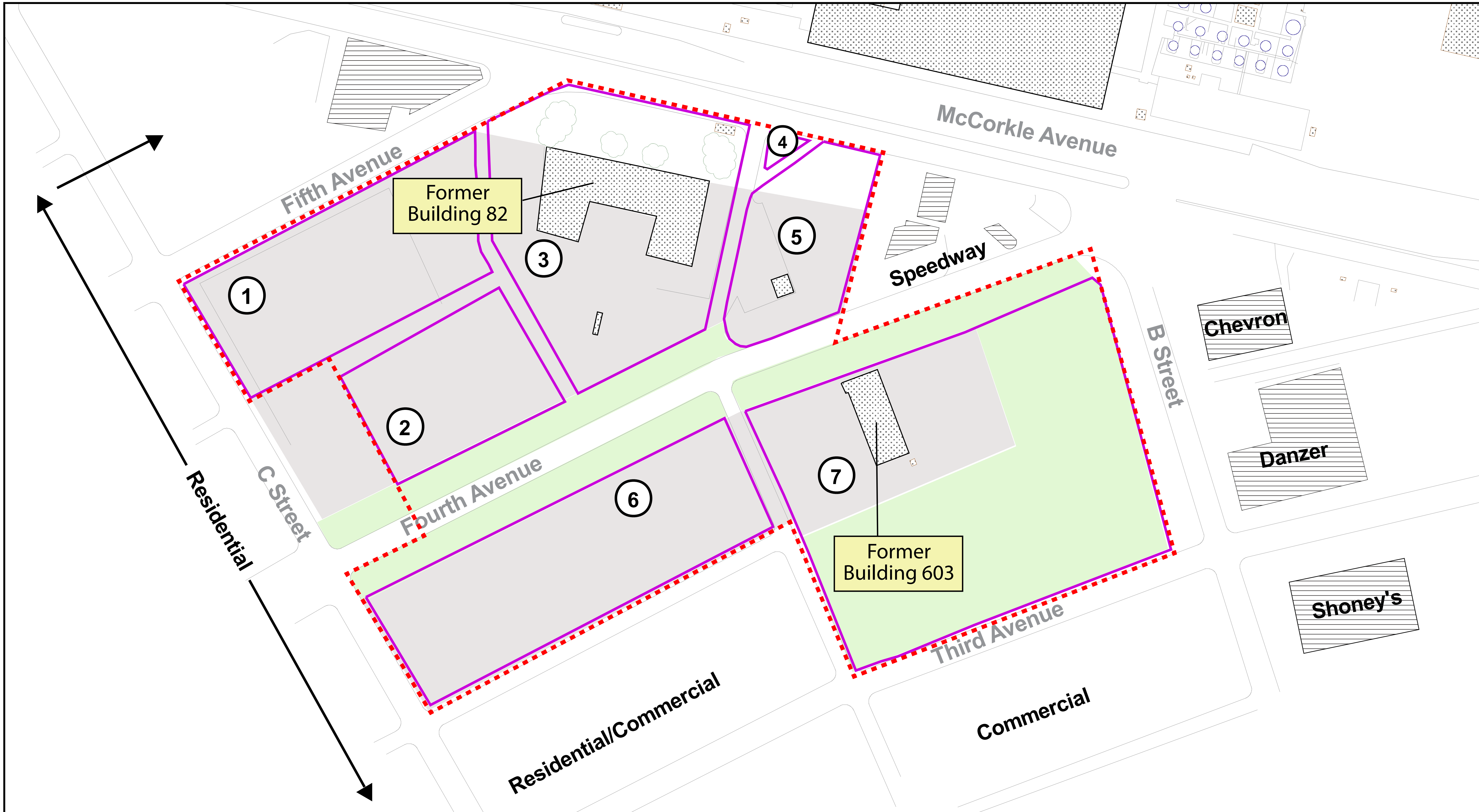

LEGEND

- Former Buildings
- Existing Buildings
- Landscaping
- Paved/Parking Lots
- Approximate Tract Boundaries
- (2) Tract Number
- Site Boundary

N

0 150 300 Feet

Figure 2-1
Building 82 Remediation Area Current Features
Building 82 Area Remedial Approach Report
UCC South Charleston Facility, South Charleston, West Virginia

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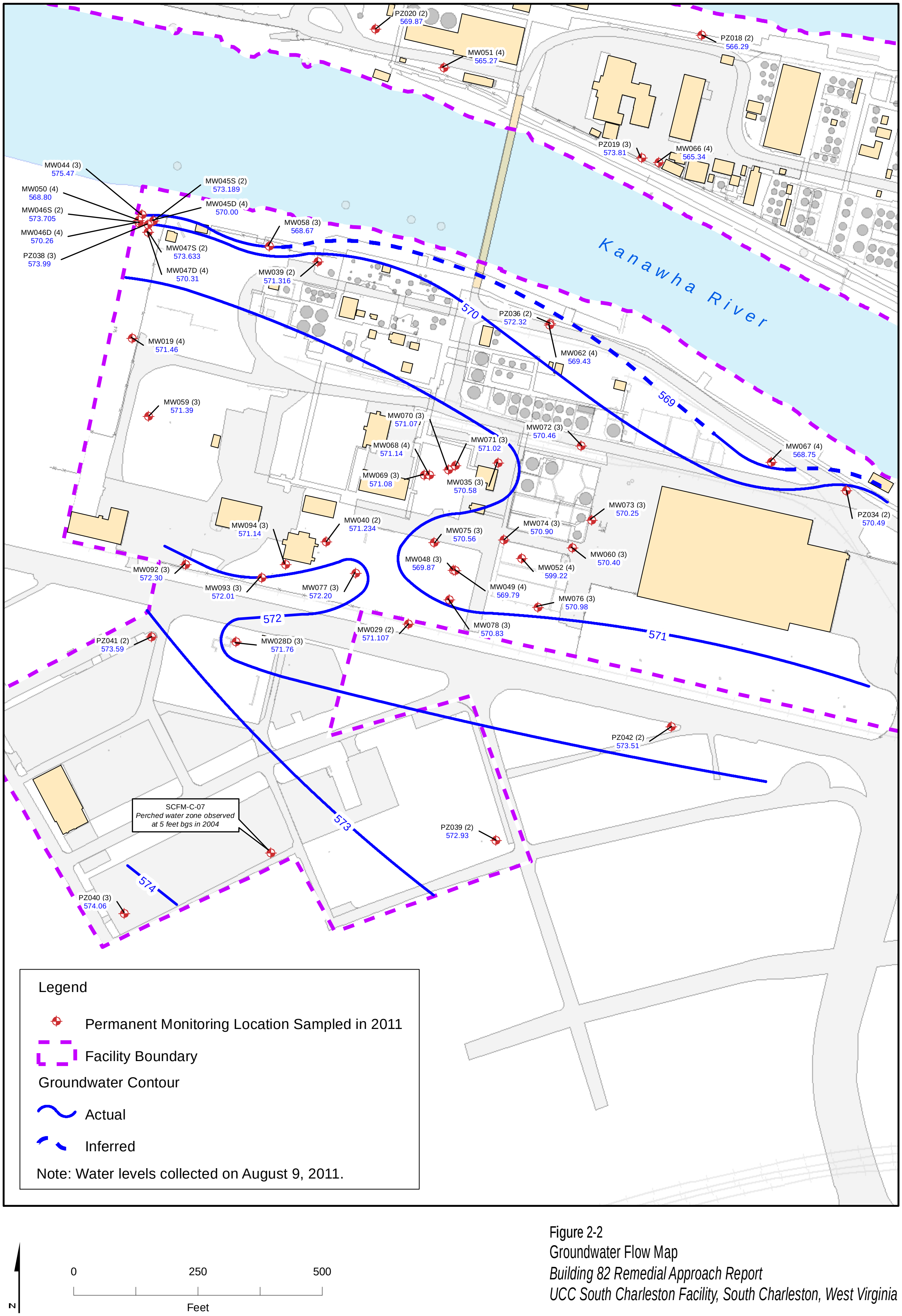

Figure 2-2
Groundwater Flow Map
Building 82 Remedial Approach Report
UCC South Charleston Facility, South Charleston, West Virginia

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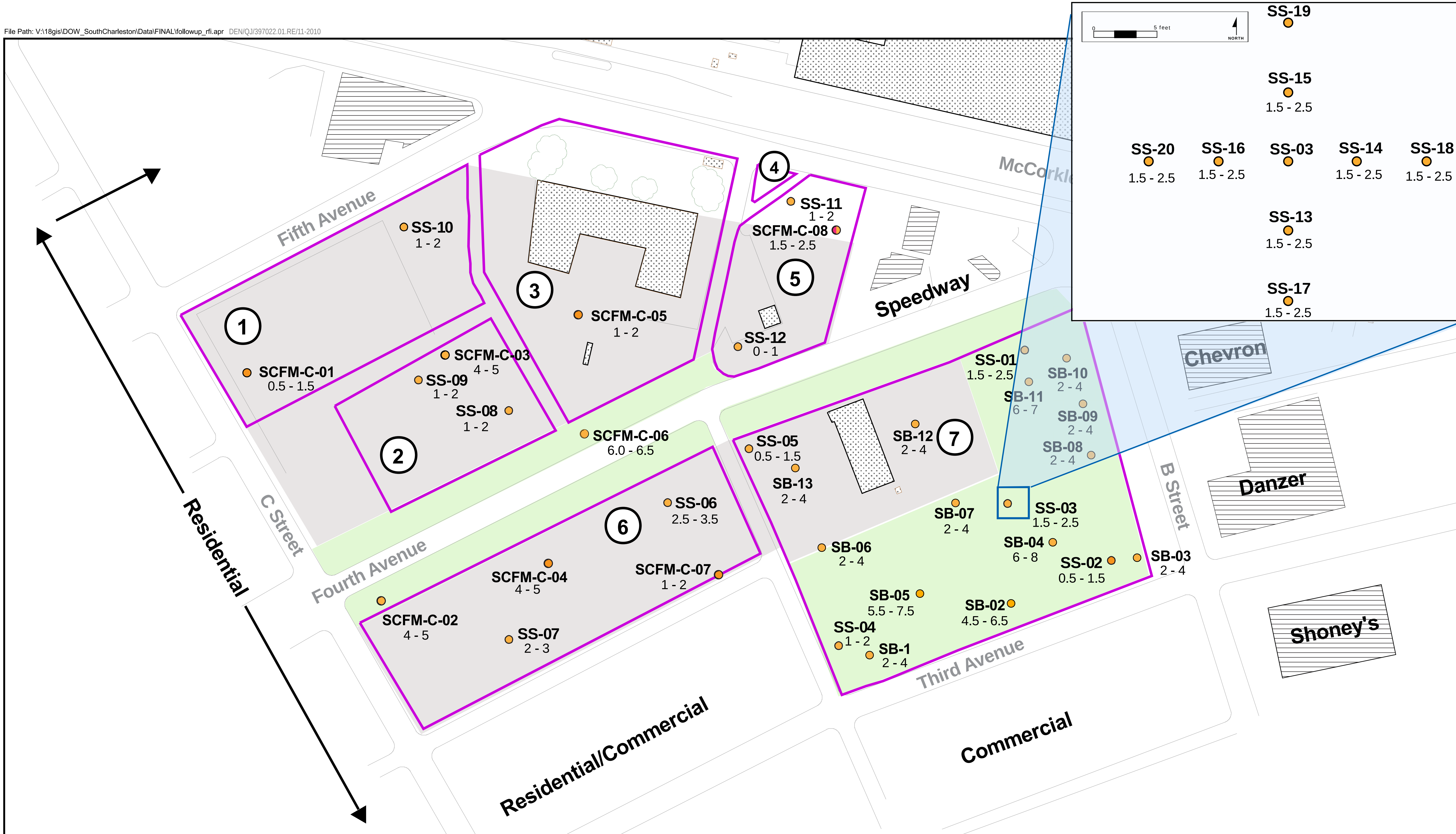

LEGEND

- Former Buildings
- Existing Buildings
- Landscaping
- Paved/Parking Lots
- Approximate Tract Boundaries
- 2 Tract Number
- Surface Soil Sample Location/Sample Depth (feet)

N

0 150 300 Feet

Figure 2-3
Soil Sampling Locations
Building 82 Area Remedial Approach Report
UCC South Charleston Facility, South Charleston, West Virginia

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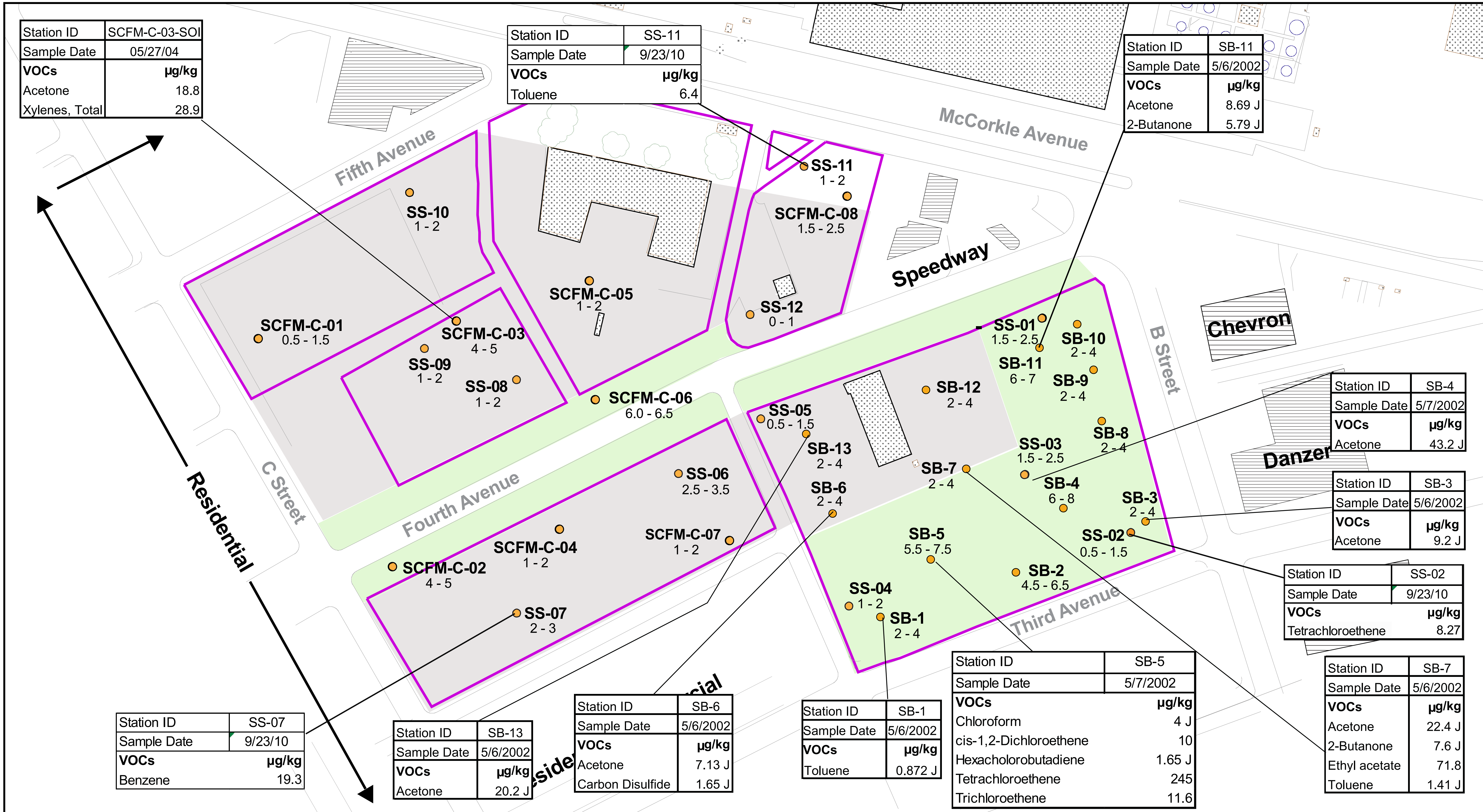

Station ID	SCFM-C-03-SOI
Sample Date	05/27/04
VOCs	**µg/kg**
Acetone	18.8
Xylenes, Total	28.9

Station ID	SS-11
Sample Date	9/23/10
VOCs	**µg/kg**
Toluene	6.4

Station ID	SB-11
Sample Date	5/6/2002
VOCs	**µg/kg**
Acetone	8.69 J
2-Butanone	5.79 J

Station ID	SB-4
Sample Date	5/7/2002
VOCs	**µg/kg**
Acetone	43.2 J

Station ID	SB-3
Sample Date	5/6/2002
VOCs	**µg/kg**
Acetone	9.2 J

Station ID	SS-02
Sample Date	9/23/10
VOCs	**µg/kg**
Tetrachloroethene	8.27

Station ID	SB-7
Sample Date	5/6/2002
VOCs	**µg/kg**
Acetone	22.4 J
2-Butanone	7.6 J
Ethyl acetate	71.8
Toluene	1.41 J

Station ID	SB-5
Sample Date	5/7/2002
VOCs	**µg/kg**
Chloroform	4 J
cis-1,2-Dichloroethene	10
Hexacholorobutadiene	1.65 J
Tetrachloroethene	245
Trichloroethene	11.6

Station ID	SB-1
Sample Date	5/6/2002
VOCs	**µg/kg**
Toluene	0.872 J

Station ID	SB-6
Sample Date	5/6/2002
VOCs	**µg/kg**
Acetone	7.13 J
Carbon Disulfide	1.65 J

Station ID	SB-13
Sample Date	5/6/2002
VOCs	**µg/kg**
Acetone	20.2 J

Station ID	SS-07
Sample Date	9/23/10
VOCs	**µg/kg**
Benzene	19.3

LEGEND

- Former Buildings
- Existing Buildings
- Landscaping
- Paved/Parking Lots
- Approximate Tract Boundaries
- Soil Sample Location/Sample Depth (feet)

µg/kg = micrograms per kilogram

J = Estimated

Sample location with no callout box indicate concentrations are non-detect.

Figure 2-4
VOC Detections in Soil
Building 82 Area Remedial Approach Report
UCC South Charleston Facility
South Charleston, West Virginia

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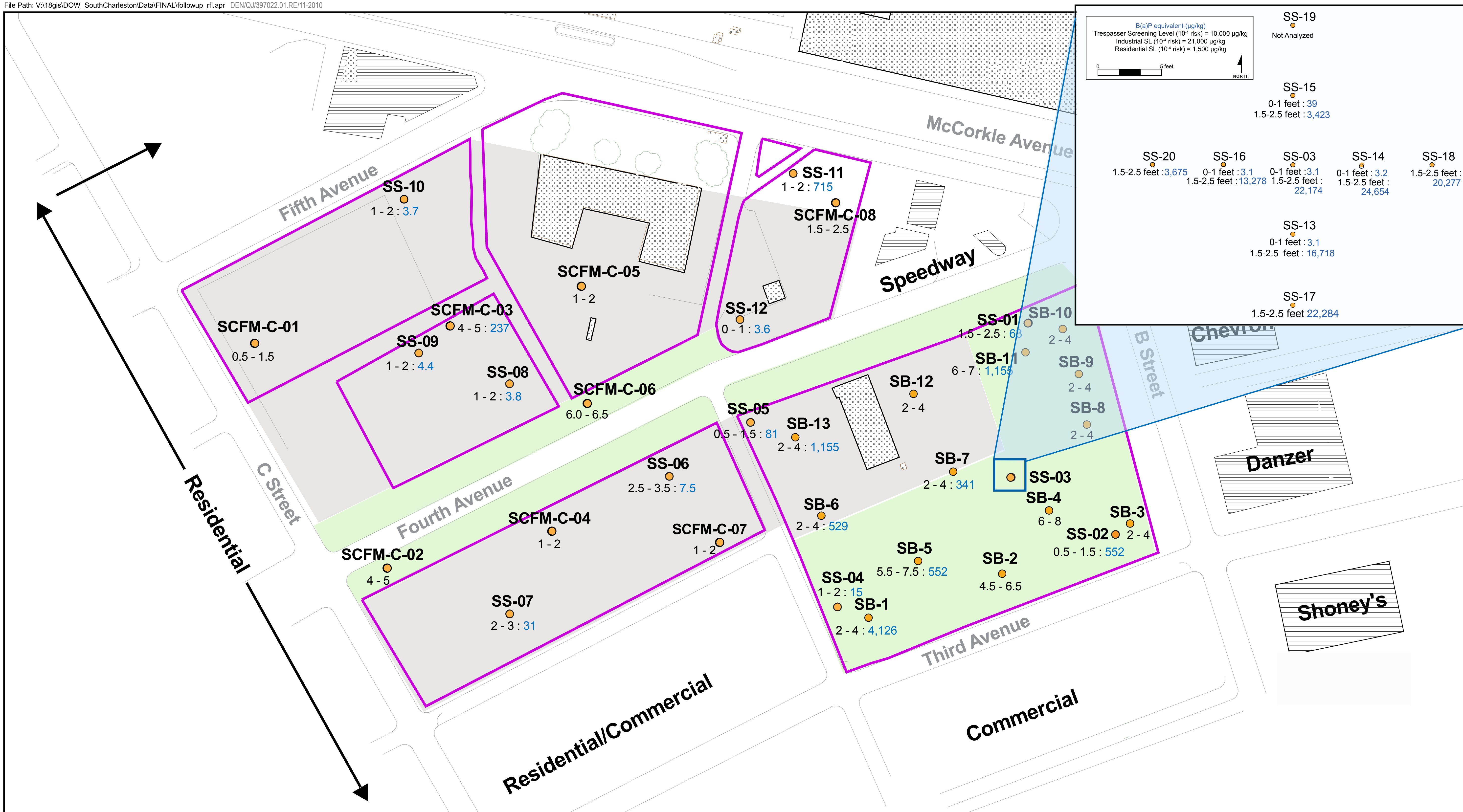

LEGEND

- Former Buildings 82 and 603
- Former Buildings 82 and 603
- Landscaping
- Paved/Parking Lots
- Approximate Tract Boundaries

Soil Sample Location/Sample Depth (feet)
µg/kg = micrograms per kilogram
J = Estimated
Benzo(a)pyrene equivalent concentration
Sample locations with no concentration
PAHs were non-detect.

N

0 150 300 Feet

Figure 2-5
B(a)P Equivalents in Soil
Building 82 Area Remedial Approach Report
UCC South Charleston Facility
South Charleston, West Virginia

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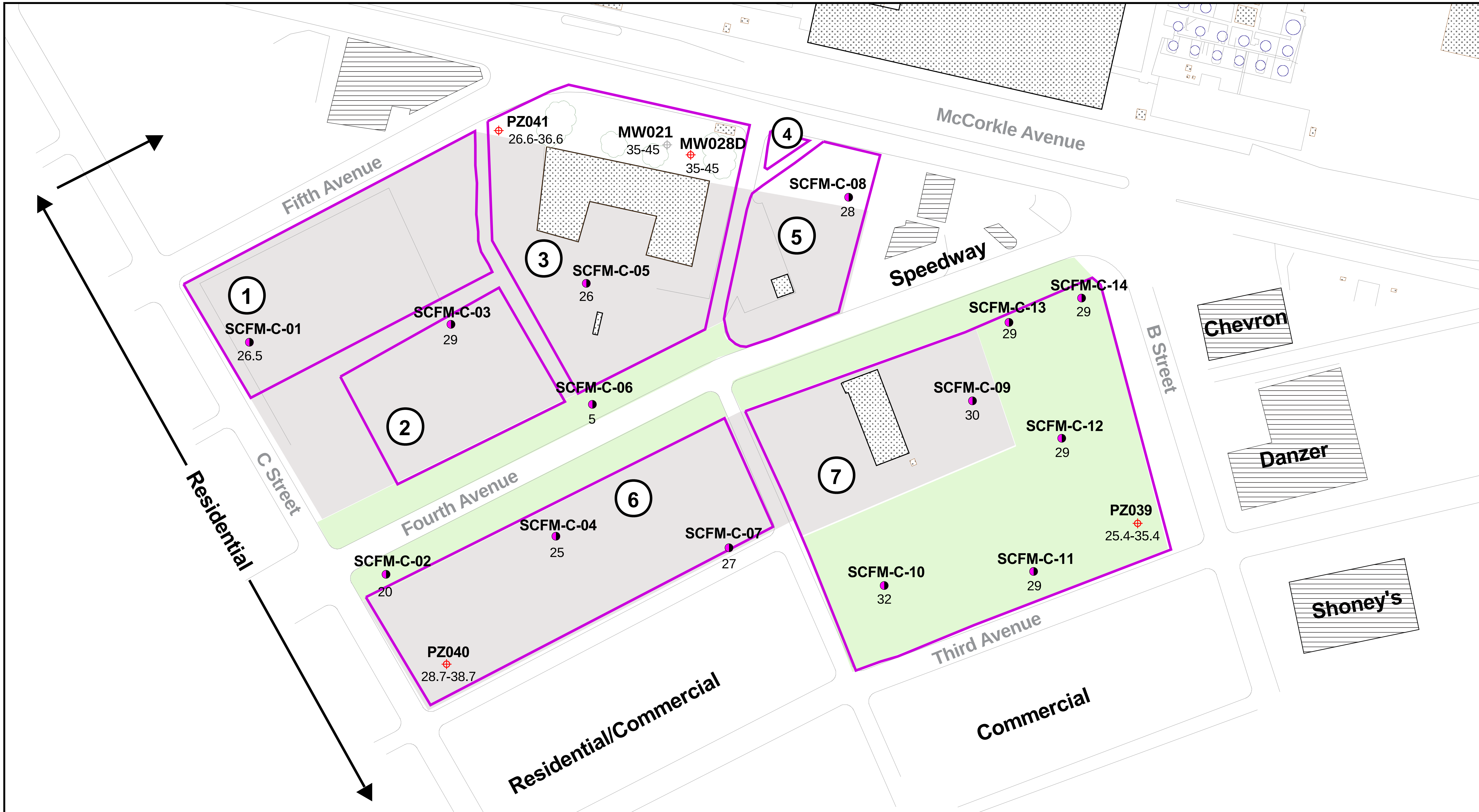

LEGEND

- Former Buildings 82 and 603
- Former Buildings 82 and 603
- Landscaping
- Paved/Parking Lots
- Approximate Tract Boundaries
- (2) Tract Number
- Groundwater Sample Location /Sample Depth (feet)
- Piezometer /Screen Interval (feet)
- Well Abandoned /Screen Interval (feet)

N

0 150 300 Feet

Figure 2-6
Groundwater Sampling Locations
Building 82 Area Remedial Approach Report
UCC South Charleston Facility, South Charleston, West Virginia

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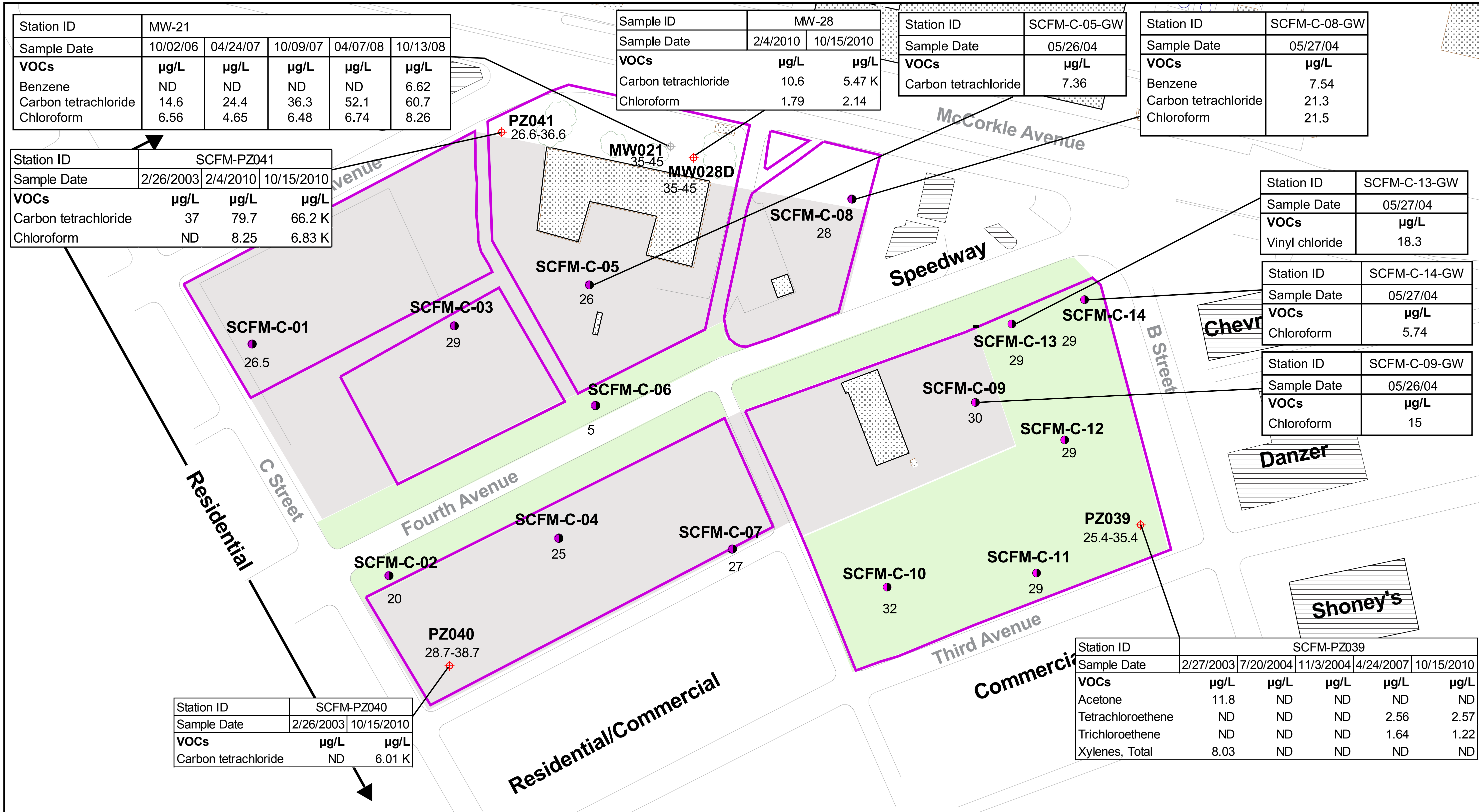

Station ID	MW-21				
Sample Date	10/02/06	04/24/07	10/09/07	04/07/08	10/13/08
VOCs	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
Benzene	ND	ND	ND	ND	6.62
Carbon tetrachloride	14.6	24.4	36.3	52.1	60.7
Chloroform	6.56	4.65	6.48	6.74	8.26

Sample ID	MW-28	
Sample Date	2/4/2010	10/15/2010
VOCs	**µg/L**	**µg/L**
Carbon tetrachloride	10.6	5.47 K
Chloroform	1.79	2.14

Station ID	SCFM-C-05-GW
Sample Date	05/26/04
VOCs	**µg/L**
Carbon tetrachloride	7.36

Station ID	SCFM-C-08-GW
Sample Date	05/27/04
VOCs	**µg/L**
Benzene	7.54
Carbon tetrachloride	21.3
Chloroform	21.5

Station ID	SCFM-PZ041		
Sample Date	2/26/2003	2/4/2010	10/15/2010
VOCs	**µg/L**	**µg/L**	**µg/L**
Carbon tetrachloride	37	79.7	66.2 K
Chloroform	ND	8.25	6.83 K

Station ID	SCFM-C-13-GW
Sample Date	05/27/04
VOCs	**µg/L**
Vinyl chloride	18.3

Station ID	SCFM-C-14-GW
Sample Date	05/27/04
VOCs	**µg/L**
Chloroform	5.74

Station ID	SCFM-C-09-GW
Sample Date	05/26/04
VOCs	**µg/L**
Chloroform	15

Station ID	SCFM-PZ039				
Sample Date	2/27/2003	7/20/2004	11/3/2004	4/24/2007	10/15/2010
VOCs	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
Acetone	11.8	ND	ND	ND	ND
Tetrachloroethene	ND	ND	ND	2.56	2.57
Trichloroethene	ND	ND	ND	1.64	1.22
Xylenes, Total	8.03	ND	ND	ND	ND

Station ID	SCFM-PZ040	
Sample Date	2/26/2003	10/15/2010
VOCs	**µg/L**	**µg/L**
Carbon tetrachloride	ND	6.01 K

LEGEND

- Former Buildings 82 and 603
- Former Buildings 82 and 603
- Landscaping
- Paved/Parking Lots
- Approximate Tract Boundaries
- Groundwater Sample Location/Sample Depth (feet)
- Piezometer/Screen Interval (feet)
- Well Abandoned/Screen Interval (feet)

µg/L = micrograms per liter
ND=None Detected
K = Biased High

Sample location with no callout box indicate concentrations are non-detect.

N

0 150 300 Feet

Figure 2-7
VOCs in Groundwater
Building 82 Area Remedial Approach Report
UCC South Charleston Facility, South Charleston, West Virginia

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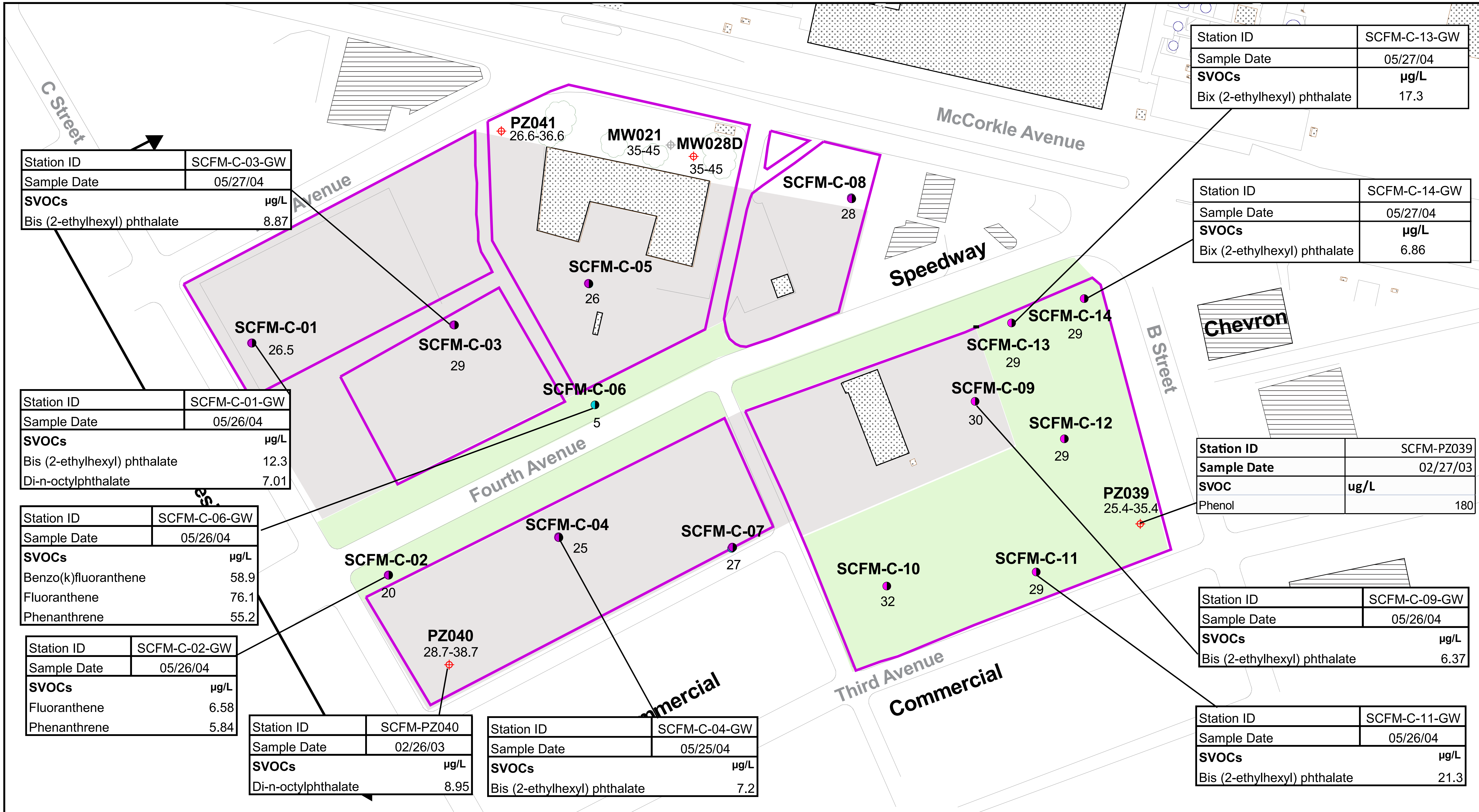

LEGEND

- Former Buildings 82 and 603
- Former Buildings 82 and 603
- Landscaping
- Paved/Parking Lots
- Approximate Tract Boundaries
- 2 Tract Number
- Groundwater Sample Location /Sample Depth (feet)
- Piezometer /Screen Interval (feet)
- Well Abandoned /Screen Interval (feet)

µg/L = micrograms per liter

Sample location with no callout box indicate concentrations are non-detect.

N

0 150 300 Feet

Figure 2-8
SVOCs in Groundwater
Building 82 Area Remedial Approach Report
UCC South Charleston Facility, South Charleston, West Virginia

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